Greetings and welcome to the **JUNE 2015** edition of the WDFW Climate News Digest. Our purpose is to provide highlights of relevant climate change news, events and resources for WDFW staff. Feedback or suggestions for items to include in future editions are much appreciated – many *thanks* to those who have sent links and references and please keep them coming. Note that previous editions of the newsletter are now stored on the Habitat Program Sharepoint site and on the agency's climate change web page.

Thanks for contributions this month from Rich Harris, Justin Allegro, Maria Hunter, Keith Folkerts, Tim Quinn, Bob Vadas, Teresa Scott and the Northwest Climate Science Digest (published by the NPLCC and the NW Climate Science Center).

WHAT'S HAPPENING AT WDFW?

The 2015 Drought

Climatologists tell us that the drought conditions we are experiencing this year are an anomaly, based on a convergence of current climate and ocean conditions. However, these conditions are indicative of what climate models tell us can be expected as "normal" later this century; higher winter temperatures and increased risk of summer drought. WDFW staff who are leading the agency's drought response are interested in what we can learn from the impacts we are experiencing now about the costs of climate change in the future. How much opportunity will we have to mitigate impacts? How can we approach our work in responding to this drought in ways that will build resilience to future droughts, or inform us as to what improving resilience might entail? If you have thoughts or suggestions, please be in touch with Teresa Scott, WDFW Drought Coordinator, or myself. We'd love to hear them as we organize this conversation. To learn more about specific climate change projections for our region, click here, for an excerpt from the National Climate Assessment. To connect to a periodic climate outlook by the Office of the State Climatologist, click here. To learn more about the impacts of the 2015 drought, contact Teresa to receive her periodic Drought Updates. Thanks!

NOTE: See below, under Learning Opportunities for a June 4th talk/webinar on the effects of Drought in Washington.

CLIMATE ADAPTATION AT OTHER ORGANIZATIONS

EPA National Water Program Releases 2014 Highlights of Progress: Responses to Climate Change by the National Water Program

EPA's National Water Program has released a 2014 Highlights of Progress Report that provides a summary of major accomplishments addressing climate change and water by the EPA National Water Program and Regional water programs during 2014. In addition, major research projects addressing climate change and water that were completed in 2014 by the EPA Office of Research and Development are also described. The Report is organized around the six long-term programmatic areas identified in the "National Water Program 2012 Strategy: Response to Climate Change," water infrastructure; watersheds and wetlands; coastal and ocean waters; water quality; working with Tribes; and cross-cutting support.
Click here to access the report.

Making Key Landscapes Resilient to Climate Change.

The Interior Department, U.S. EPA and NOAA have announced four landscapes – in southwest Florida, Hawaii, **Puget Sound** and the Great Lakes—where agencies will focus their efforts with partners to conserve and restore important lands and waters and make them more resilient to a changing climate. These Resilient Lands and Waters projects will build climate resilience in vulnerable regions and enhance carbon

storage capacity, focusing on increasing coastal resilience, developing coastal wetlands and marine conservation areas, protecting drinking water for urban areas, providing wildlife habitats, and preventing threats like flooding and invasive species.
Click here to read the press release.

Climate Change Specialist Position

The Sauk-Suiattle Tirbe is hiring a climate change coordinator positions. You can find out more information here, www.sauk-suiattle.com. Any questions about the position can be directed towards the Natural Resources Director-Jason Joseph jjoseph@sauk-suiattle.com, the Fisheries Biologist-Grant Kirby gkirby@sauk-suiattle.com, the Water Quality Specialist-Scott Morris smorris@sauk-suiattle.com, and/or the Wildlife Biologist-Emily Wirtz ewirtz@sauk-suiattle.com

EPA Climate Ready Estuaries Program Releases Video about San Juan Bay Vulnerability Assessment

Using the EPA publication, "Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans," the San Juan Bay (Puerto Rico) National Estuary Program developed a risk-based climate change vulnerability assessment. A new video describes some of the climate change impacts already affecting San Juan, documents why the San Juan Bay National Estuary Program undertook this vulnerability assessment project, and explains the benefits of conducting the study.
Click here to view the video.
Click here to view the Climate Ready Estuaries website.

LEARNING OPPORTUNITIES

June 4th, 11:45 – 12:45, "Green Bag" Webinar: Drought: The Future of Water in Washington, *sponsored by DOH Climate Change Workgroup*

Ginny Stern, hydrogeologist with the DOH Office of Drinking Water, will discuss how reduced snowpack, drought, and water resource management will increasingly affect public health and Washington's landscape. Mindy Roberts and Jim Shedd from the WA Department of Ecology will talk about impacts on streams, Puget Sound, and the health of fish and wildlife. **Point Plaza East, room 152-153 or by webinar**. For more information, contact Ann Butler, 360-236-3731.

Sixth Annual Northwest Climate Conference

November 4-5, 2015 | Coeur d'Alene, Idaho
http://pnwclimateconference.org/
Abstracts for oral and poster presentations, as well as proposals for special sessions, are due by 11:00 pm Pacific on Friday, June 26, 2015. Submissions are requested for a range of topics related to regional climate, climate impacts, and climate adaptation science and practice. Presentations and special sessions that connect science to management decisions and the implementation of adaptation actions are strongly encouraged.
About the conference. The NW Climate Conference (formerly known as the Pacific Northwest Climate Science Conference) annually brings together more than 250 researchers and practitioners from around the region to discuss scientific findings, challenges, and solutions related to the impacts of climate on people, natural resources, and infrastructure in the northwestern United States and southwestern Canada

EPA Local Government Climate Adaptation Training Module Available Online

EPA has released an online training module to help local government officials take actions to increase their communities' resiliency to a changing climate. The virtual training, which lasts about 30 minutes, was

developed with EPA's Local Government Advisory Committee. It illustrates how a changing climate may affect a variety of environmental and public health services, describes how different communities are already adapting to climate-related challenges, and links to a number of federal and state resources that can help communities assess their unique climate-related risks and opportunities to become more resilient to climate change.
Click here to access the online training.

Tribal Climate Change Webinar Series Announced for May-June 2015

This series of four webinars will introduce the Local Environmental Observer (LEO) network, discuss extreme weather events, and delve into the impacts of climate change on human health and fish and wildlife. The webinars are being offered by the Institute for Tribal Environmental Professionals (ITEP) at Northern Arizona University with support from EPA.
Click here to learn more about the webinars and to register.

RESOURCES

Climate Data Primer

Ready to learn some of the basics about climate data? Find out about measuring, modeling, and predicting climate and ways to find and use climate data with the Maps & Data Climate Data Prime, from Climate.gov.

Local Climate Action Framework: A Step-by-Step Implementation Guide

This online guide provides step-by-step guidance and resources for local governments to plan, implement, and evaluate climate, energy, and sustainability projects and programs to reduce greenhouse gas emissions and adapt to climate change impacts. It captures lessons learned and effective strategies used by local governments, breaks down program implementation into concrete steps, and curates resources to help local governments find the information they need. The framework was developed with extensive input from local government stakeholders, including EPA's Climate Showcase Communities.

How to Use Instagram to Track Climate Change

It's social media's ability to so easily capture and share these observations that inspired a new citizen science project, using tools like Instagram and Twitter to document evidence of climate change. The project, named ISeeChange, was founded in 2013 by environmental reporter Julia Kumari Drapkin, who dreamed up the experiment while reporting on climate issues in Western Colorado. This year, the program expands nationally, with eight radio stations across the country recruiting reports, as well as a partnership with NASA scientists working on the Jet Propulsion Laboratory's Orbiting Carbon Observatory, the first dedicated satellite for studying atmospheric carbon dioxide.

New Book - Biodiversity in a Changing Climate

The new book "Biodiversity in a Changing Climate - Linking Science and Management in Conservation" includes California focused case studies and best practices used to address impacts related to climate change across a broad spectrum of species and habitats - from coastal krill and sea urchins to prairie grass and mountain bumblebees. Click here for more information.

U.S. Geological Survey Publishes Water-Energy Nexus Report

The United States Geological Survey (USGS) has published a report entitled, "The Water-Energy Nexus: An Earth Science Perspective." The intent of this report is to provide scientific insight to resource managers and the general public on the complex ways in which water and energy are interconnected and to highlight the important issues that affect availability and sustainability of water and energy resources in the U.S.

Issues analyzed and discussed in the report include freshwater availability, water use, ecosystems health, assessment of fossil-fuel, and other energy sources, the subsurface injection of wastewater, carbon, and much more.
Click here to access the report.

U.S. Climate Resilience Toolkit - Disease Maps

View maps displaying seasonal tracking of seven vector-borne diseases-including West Nile virus, several types of encephalitis, and Dengue Fever-in the United States. Each map provides links to background, historical, and other information for each disease.
Explore more tools to build resilience.

New Interactive Education Module on Climate Change Effects

The US Forest Service's Climate Change Resource Center (CCRC) has released a new interactive online education module on climate change effects on forests and grasslands. The CCRC's first education module provides a basic climate change foundation, and this new module builds on that foundation, examining climate change effects around the country. Explore the Modules >>

USDA Releases Fact Sheet on Framework for Building Blocks for Climate Smart Agriculture & Forestry

The U.S. Department of Agriculture (USDA) is announcing a comprehensive and detailed approach to support farmers, ranchers, and forest land owners in their response to climate change. The framework consists of 10 building blocks that span a range of technologies and practices to reduce greenhouse gas emissions, increase carbon storage, and generate clean renewable energy. USDA's strategy focuses on climate-smart practices designed for working production systems that provide multiple economic and environmental benefits in addition to supporting resilience to extreme weather, reduced emissions and increased carbon storage. Click here to read the Fact Sheet.

CLIMATE SCIENCE NEWS

Links to recent articles related to changing ocean conditions

(provided by Tony Meyer, Executive Director, Lower Columbia RFEG, via Bob Vadas)
1. PICES: https://www.pices.int/publications/pices_press/volume23/PPJanuary2015.pdf scroll down to pages 36-38.
2. Audubon: https://www.audubon.org/magazine/march-april-2015 scroll down and click on "Lost at sea: starving seabirds in a warmer world".
3. National Geographic: http://news.nationalgeographic.com/2015/04/150411-Pacific-ocean-sea-lions-birds-climate-warming-drought/
4. Science: http://www.sciencemag.org/content/348/6230/17.full?sid=b34bb649-0a02-4811-ac6c-459bff66c904

OWSC Newsletter

The May edition of the Office of the Washington State Climatologist newsletter is now available here, and attached to this email. Topics include:
April climate summary, announcement of updates to our trend analysis tool, historical heavy rain in May, new weekly drought monitoring report, temperature and precipitation outlook

State of the Climate: March 2015 and first quarter of year warmest on record

The globally averaged temperature over land and ocean surfaces for March 2015 was the highest for the month since record keeping began in 1880. The year-to-date (January-March) globally averaged temperature was also record high, according to NCDC's March State of the Climate Report.
Read more »

Climate Science: The Future of Coastal Ocean Upwelling

Many climate models predict that coastal upwelling will intensify in three of the most productive marine ecosystems of the world. This result comes at a time when scientists are still debating the evidence supporting an increase in coastal upwelling and its effects on coastal ecosystems and global carbon cycling. Increased upwelling currents will strongly affect marine ecosystems at Eastern Boundary Upwelling Systems, but the long-term future of coastal acidification, dead zones, and primary productivity probably depends on the properties of the water that comes to the surface:
http://www.nature.com/nature/journal/v518/n7539/full/518310a.html

Accelerate Glacier Melt on Mt. Olympus due to Carbon and Dust from Wildfire

Assessing the potential for black carbon and dust deposition to reduce albedo and accelerate glacier melt is of interest in Washington because snow and glacier melt are an important source of water resources, and glaciers are retreating. In August 2012 on Snow Dome Mt Olympus, Washington, researchers measured snow surface spectral albedo and collected surface snow samples and a 7 m ice core. The samples were microscopically analyzed for iron, black carbon, and charcoal. Results show that black carbon and dust deposition was a magnitude higher in 2011 than 2012, and identified the 2011 Big Hump forest fire on the Olympic Peninsula as the source of the greatly elevated impurity deposition. The forest fire impurity reduced albedo, increased the radiative forcing, and enhanced snowmelt.

Phytoplankton, reducing greenhouse gases or amplifying Arctic warming?

(from Science Daily)

Scientists have presented the geophysical impact of phytoplankton that triggers positive feedback in the Arctic warming when the warming-induced melting of sea ice stimulates phytoplankton growth. When the Arctic sea ice melts away due to greenhouse warming, the ocean surface albedo inevitably decreases, reducing the amount of solar energy reflected back from Earth and ultimately resulting in warmer ocean surface. As phytoplankton growth is subject to factors such as temperature, light, and nutrients, the explosive growth of phytoplankton follow when both the warming-induced melting and shortwave radiation penetrating the ocean increase. The new study has confirmed that it is the beginning of the geophysical feedback by which chlorophyll and the related pigments in phytoplankton absorb solar radiation and in turn raise the sea surface temperature even further. Using a coupled ocean-atmosphere model, the authors have revealed that the additional positive feedback in the Arctic can amplify Arctic warming by as much as 20%.

SPECIES AND HABITATS

Relative sensitivity to climate change of species in northwestern North America (attached)

(excerpt from the abstract)

Managing species in the face of climate change will require an understanding of which species will be most sensitive to future climatic changes and what factors will make them more sensitive. The inherent sensitivity of species to climate change is influenced by many factors, including physiology, life-history traits, interspecific relationships, habitat associations, and relationships with disturbance regimes. Using a combination of scientific literature and expert knowledge, we assessed the relative sensitivity to climate change of 195 plant and animal species in the northwestern North America. We found that although there were highly sensitive species in each of the taxonomic groups analyzed, amphibians and reptiles were, as a

group, estimated to be the most sensitive to climate change. Not surprisingly, we found that the confidence that experts had in their assessments varied by species. Our results also indicate that many species will be sensitive to climate change largely because they depend on habitats that will likely be significantly altered as climates change. Case MJ, Lawler JJ, Tomasevic JA (2015) Relative sensitivity to climate change of species in northwestern North America. Biological Conservation 187:127-133.

NOAA Study Finds Marshes, Reefs, Beaches Can Enhance Coastal Resilience

This study highlights strengths and weaknesses of the coastal protection benefits provided by built infrastructure, natural ecosystems, and the innovative opportunities to combine the two into hybrid approaches for coastal protection. The study also examines cases where hybrid approaches are being implemented to improve coastal resilience as well as some of the policy challenges that can make implementation of these approaches more difficult. The study highlights top priorities for research, investment, and the application of natural and hybrid approaches. This information is critical to facilitate adoption of these approaches in planning and decision-making at all levels to enhance the resilience of our coasts.

Click here to access the study.

Soil nutrients may limit ability of plants to slow climate change

Many scientists assume that the growing level of carbon dioxide in the atmosphere will accelerate plant growth. However, a new study suggests much of this growth will be curtailed by limited soil nutrients.

High mountains warming faster than expected

(from Science Daily)

High elevation environments around the world may be warming much faster than previously thought, according to members of an international research team. High mountains are the major water source for large numbers of people living at lower elevations, so the social and economic consequences of enhanced warming in mountain regions could be large. The researchers state that "this alone requires that close attention be paid to the issue. In addition, mountains provide habitat for many of the world's rare and endangered species, and the presence of many different ecosystems in close proximity enhances the ecological sensitivity of mountains to environmental change."

Effects of climate and plant phenology on recruitment of moose at the southern extent of their range (attached)

This study examined effects of climate and growing-season phenology on recruitment (8–9 months old) of young Shiras moose (*Alces alces shirasi*)
over three decades, from 18 herds, across a large geographic area encompassing much of the southern extent of their range. Recruitment declined in 8 of 18 herds during 1980–2009, whereas others did not exhibit a temporal trend (though none showed a positive trend).

Climate-related disruptions of marine ecosystems: Decades to destroy, millennia to recover

(*from Science Daily)*

A new study reports that marine ecosystems can take thousands, rather than hundreds, of years to recover from climate-related upheavals. The study's authors analyzed thousands of invertebrate fossils to show that ecosystem recovery from climate change and seawater deoxygenation might take place on a millennial scale**.** A 30-foot-long core sample of Pacific Ocean seafloor is changing what we know about ocean resiliency in the face of rapidly changing climate. The scientific collaborative--led by Sarah Moffitt, PhD, from the UC Davis Bodega Marine Laboratory and Coastal and Marine Sciences Institute--analyzed more than 5,400 invertebrate fossils, from sea urchins to clams, within a sediment core from offshore Santa

Barbara, California. "In this study, we used the past to forecast the future," says Roopnarine, Academy curator of invertebrate zoology and geology. "Tracing changes in marine biodiversity during historical episodes of warming and cooling tells us what might happen in years to come. We don't want to hear that ecosystems need thousands of years to recover from disruption, but it's critical that we understand the global need to combat modern climate impacts."

Tracking Tree Movement Along the West Coast

Researchers from the Pacific Northwest Research Station and Oregon State University published a paper titled, “Evidence of tree species' range shifts in a complex landscape.” They compared the distribution of seedlings and mature trees for all but the rarest tree species in California, Oregon and Washington, a large, environmentally diverse region. Across 46 species, the mean annual temperature of the range of seedlings was 0.120°C colder than that of the range of trees. The extremes of the seedling distributions also shifted towards colder temperature than those of mature trees, but the change was less pronounced. Although the mean elevation and mean latitude of the range of seedlings was higher than and north of those of the range of mature trees, elevational and latitudinal shifts run in opposite directions for the majority of the species, reflecting the lack of a direct biological relationship between species’ distributions and those variables. The broad scale, environmental diversity and variety of disturbance regimes and land uses of the study area, the large number and exhaustive sampling of tree species, and the direct causal relationship between the temperature response and a warming climate, provide strong evidence to attribute the observed shifts to climate change.

Monleon, V. J., & Lintz, H. E. (2015). Evidence of Tree Species’ Range Shifts in a Complex Landscape. *PLoS ONE*, doi: http://dx.doi.org/10.1371/journal.pone.0118069

POLICY AND MANAGEMENT - MITIGATION AND ADAPTATION

The Need for Social Sciences In Climate Policy

Interesting and well-argued article on the need for greater representation of the social sciences in climate policy.

Obama Offers Major Blueprint on Climate Change

(From the New York Times)

President Obama recently unveiled his blueprint for cutting United States greenhouse gas pollution by nearly a third over the next decade. Mr. Obama’s plan, part of a formal submission to the United Nations ahead of efforts to forge a climate change accord in Paris in December, detailed the United States side of an ambitious joint climate change pledge the president made in November in Beijing with the Chinese president Xi Jinping. In an effort to spur other countries to enact their own domestic climate change plans leading to the Paris accord, the leaders of the world’s two largest greenhouse gas polluters offered the outline of a set of climate actions.

New Executive Order Focuses on Sustainability within the Federal Government

On March 19, 2015, President Obama signed an Executive Order that will ensure that the federal government leads by example as the United States moves to reduce greenhouse gas emissions while boosting clean energy. With a footprint that includes 360,000 buildings, 650,000 fleet vehicles, and $445 billion spent annually on goods and services, the federal government's actions to reduce pollution, support renewable energy, and operate more efficiently can make a significant impact on national emissions. The Executive Order outlines a number of measures to make the federal government's operations more sustainable, efficient and energy-secure, including directing federal agencies to cut their greenhouse gas emissions by 40% by 2025, and reducing water intensity in federal buildings by 2 percent per year through

2025.
Click here to access the Executive Order.
Click here for the Fact Sheet.

California Takes Action to Reduce Climate Change
Governor Jerry Brown issued an Executive Order to establish a California greenhouse gas reduction target of 40 percent below 1990 levels by 2030, leading the nation in unprecedented action against climate change. The executive order also calls for various steps to implement priority climate adaptation actions. Click here to read more.

Dutch citizens sue the government for failing to protect them against climate change
http://billmoyers.com/2015/04/10/landmark-dutch-lawsuit-puts-governments-around-world-notice/